Journal of the American Pomological Society 60(3):129-135 2006

# Performance of 20 Muscadine Grape Cultivars in North Florida

Peter C. Anderson[1]


## Abstract

Vine yield, vigor, and attributes of berry quality of 20 cultivars of muscadine grapevines (*Vitis rotundifolia* Michx.) were determined at the North Florida Research and Education Center-Quincy from 2002-2005. The performance of many of the new muscadine grape cultivars in this trial has not been previously evaluated. The grape cultivars may be categorized by berry size: 1) small self fruitful ('Carlos', 'Creek', 'Noble'); 2) medium self fruitful ('Alachua', 'Regale'); medium-large self fruitful ('Granny Val', 'Pineapple', 'Polyanna', 'Tara', 'Triumph'), and 4) large female or pistillate ('Black Beauty', 'Black Fry', 'Early Fry', 'Fry', 'Jumbo', 'Pam', 'Scarlet', 'Summit', 'Supreme', 'Sweet Jenny') cultivars. 'Noble' and 'Carlos' had the highest vigor and consistently produced the highest yield (estimated at 45 kg/vine) and they are the two best cultivars for juice or wine production. Soluble solids of the muscadine cultivars at harvest ranged from 15 to 19 °Brix with 'Fry', 'Polyanna', 'Scarlet', and 'Summit' having the highest and 'Jumbo' and 'Regale' the lowest soluble solids. Large-fruited cultivars that are particularly suitable to direct to consumer operations included 'Black Beauty', 'Fry' and 'Pam'. 'Supreme' produced very large berries, but vine vigor was low due, in part, to overcropping. Good pollenizers for the pistillate cultivars listed above were 'Granny Val', 'Polyanna' and 'Tara'.


## Introduction

The Muscadine grape (*Vitis rotundifolia* Michx.) is endemic to the southeastern United States and was the first grapevine species to be cultivated in North America. Olien (9) reported that there were about 1,600 ha planted in the southeastern United States with approximately 200 ha in Florida. Wild muscadine grapes are dioecious due to incomplete stamen production in female vines and incomplete pistil formation in male vines. Many large-fruited muscadine grapevines are female and self-fruitful cultivars are usually planted nearby to serve as pollenizers. Typically, muscadine grapes in the wild bear dark fruit. Bronze fruit are also found in the wild and they are generically known as "scuppernong". There is also one improved cultivar from the Scuppernong River known as 'Scuppernong'. Muscadine grapes typically bear between 4 and 10 fruit per cluster. There are over 100 improved cultivars of muscadine grapes that vary in size from 3 to 15 g. Skin color varies from bronze, bronze-green, pink, dark purple to black.

Most cultivars of muscadine grapes are resistant to insects and diseases, and as such, are a sustainable crop. They are well suited for organic culture. The advantages of muscadine grape production compared to that of Euvitis grapes in the southeastern United States include better resistance to pests, higher yields and increased vine longevity (9). They are resistant to Pierce's disease which precludes the successful culture of *Vitis vinifera* grapes in the southeastern most states. Disadvantages include uneven ripening, thick skin, lack of seedlessness, a wet scar, a rather distinct and strong muscadine flavor and low prices offered by processors (9). There have been many reports concerning muscadine grapes for fresh production and for processing from Florida (1, 2, 3, 4, 7, 8, 10). Many new cultivars of muscadine grapes have been released over the last 15 years, although few have been evaluated in replicated trials. Breeding programs of muscadine grapes exist (or have existed) in Florida, Georgia, Mississippi and North Carolina, and there are now a high number of large-fruited cultivars available for trial.

[1] Professor of Horticulure. University of Florida Institute of Food and Agricultural Sciences, North Florida Research and Education Center-Quincy, 155 Research Rd., Quincy, FL 32351. Email: pcand@ufl.edu

Yields for wine and juice grapes such as 'Carlos' and 'Noble' can exceed 18 t/ha (1, 2, 3, 7, 8, 10); however, low prices offered by processors ($200/t) have made this a risky business decision (9). The muscadine cultivars with a large berry size can be marketed by U-Pick operations or direct to consumer outlets at a much higher price than the juice or wine grapes. Profitability of growing fresh market grapes is largely dependent upon location, and the ability to enfranchise market avenues. Although there have been many publications involving the performance of muscadine grapevines (1, 2, 3, 6, 7, 8, 10), there are no published quantitative data available for many of the genotypes in this trial.

## Materials and Methods

A 0.25 ha vineyard was established during February 2000 at the NFREC-Quincy. (Location: 30° 64' North Latitude, 84° 68' West Longitude). This site had been fallow with mainly Bahia grass for at least 20 years prior to vineyard establishment. The vineyard consisted of 20 cultivars of muscadine grapes (*Vitis rotundifolia* Michx.). The cultivars in the trial included 'Alachua', 'Black Beauty', 'Black Fry', 'Carlos', 'Creek', 'Early Fry', 'Fry', 'Granny Val', 'Jumbo', 'Noble', 'Pam', 'Pineapple', 'Polyanna', 'Regale', 'Scarlett', 'Summit', 'Supreme', 'Sweet Jenny', 'Tara' and 'Triumph'. One plant of each cultivar was planted in each of 6 rows. The experimental design was a randomized complete block design. Plant spacing was 4.6 and 3.0 m within and between rows, respectively. Vines were trained to a bilateral cordon to a height of 1.8 m. Formation of the trunk and cordons were completed for most cultivars during the establishment year. Vines were pruned to 2- to 4-node spurs during the dormant season (January-February). Typically spurs occurred every 12 to 25 cm on a cordon. Drip irrigation was installed and irrigation was applied every day or two during the establishment year and on an as needed basis during subsequent years. Soil type was an Orangeburg loamy fine sand (Typic Paleudult: Silaceous Thermic). Vines were fertilized with 10N-4.4P-8.3K plus micronutients at the rate of 0.9 kg per plant during the dormant seasons. A 1.5 m wide in-row strip was maintained by the use of glyphosate, [N-(Phosphonomethyl) glycine], and paraquat (1, 1'-dimethyl-4, 4'-dipyridinium). Insecticides or fungicides were not applied.

In September of each year from 2002-2005 total yield was estimated on a scale of 1 to 10, with 10 being roughly equivalent to 45 kg/per vine. Vigor was estimated from 1 to 10 based on vine growth and leaf appearance. A value of 10 corresponded to a complete curtain of green shoots and leaves positioned vertically. Average berry weight was determined by weighing 10 randomly chosen berries from each vine. Berries were crushed and soluble solids (°Brix) of berry juice was measured with a digital refractometer.

Data were collected from 2002 to 2005 and subjected to analysis of variance. The experimental design was a randomized complete block with one vine of each cultivar randomly assigned to each of six rows. Data were first analyzed as a factorial design with cultivar and year as the main factors and cultivar*year interactions. Mean separation of data for each year was analyzed by Duncan's multiple range test ($P<0.05$).

## Results and Discussion

There were highly significant cultivar and year effects on yield, berry weight and soluble solids of muscadine grapevines (Table 1). There was not a significant effect of year on vine vigor. Significant cultivar*year interactions only occurred for yield therefore yield data for each year are included (Table 2), otherwise mean data from 2002-2005 are reported (Table 3).

There were significant cultivar, year and cultivar*year effects on yield.(Table 2) Yield ratings were on a scale of 1 to 10 (highest); adequate vigor and yield would be rated as 7. We have no indication that yield was reduced

**Table 1.** The effect of cultivar, year and cultivar * year interactions on vine vigor, yield, berry weight and soluble solids of 20 cultivars of muscadine grapes at the NFREC-Quincy from 2002-2005.
Statistics (P<)

| Variable | Cultivar | Year | Cultivar * Year |
|---|---|---|---|
| Vine vigor | 0.0001 | NS | NS |
| Yield | 0.0001 | 0.0017 | 0.0003 |
| Berry wt. | 0.0001 | 0.0001 | NS |
| Soluble solids | 0.0001 | 0.0001 | NS |

**Table 2.** Yield estimates of 20 cultivars of muscadine grapevines at the NFREC-Quincy from 2002-2005.

| Cultivar | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|
| Alachua | 6.7 abcd[z] | 8.0 abc | 7.9 abcd | 6.6 abcd |
| Black Beauty | 6.3 bcd | 7.3 abc | 5.8 cdef | 8.0 bcdef |
| Black Fry | 5.8 bcd | 5.8 bcd | 5.8 cdef | 5.4 bcd |
| Carlos | 7.0 abcd | 8.8 ab | 9.8 a | 9.0 ab |
| Creek | 6.3 bcd | 8.8 ab | 10.0 a | 5.0 bcd |
| Early Fry | 4.7 d | 4.3 d | 3.3 fg | 4.5 cd |
| Fry | 5.5 bcd | 7.5 abc | 6.8 bcde | 5.3 bcd |
| Granny Val | 9.5 a | 8.0 abc | 8.8 ab | 4.8 gh |
| Jumbo | 6.3 bcd | 9.0 a | 4.7 efg | 6.5 abcd |
| Noble | 8.4 ab | 9.2 a | 9.8 a | 10.0 a |
| Pam | 6.3 bcd | 7.0 abcd | 9.0 ab | 3.0 d |
| Pineapple | 5.4 def | 7.8 abc | 8.8 ab | 5.0 bcd |
| Polyanna | 5.0 d | 7.3 abc | 6.0 cdef | 7.3 abc |
| Regale | 8.2 abc | 7.2 abcd | 9.3 ab | 8.0 abc |
| Scarlet | 5.6 bcd | 4.3 d | 5.6 def | 7.0 abcd |
| Summit | 6.0 bcd | 7.7 abc | 8.4 abc | 7.2 abcd |
| Supreme | 5.5 ef | 6.8 abcd | 2.5 g | 8.0 abc |
| Sweet Jenny | 5.7 bcd | 5.0 cd | 7.8 abcd | 7.2 abcd |
| Tara | 4.4 d | 5.6 cd | 6.6 bcde | 7.0 abcd |
| Triumph | 4.5 d | 4.3 d | 6.8 bcde | 7.5 abc |

[z]Yield was estimated from 1 (lowest) to 10 (highest). Yield estimate of 10 was roughly equivalent to 45 kg/vine. Mean values not followed by a letter in common within a column are significantly different by Duncan's multiple range test, P<0.05.

as a result of not applying insecticides or fungicides, although berry blemishes sometimes occurred in certain bronze-colored cultivars. Average yield ratings for 2002, 2003, 2004 and 2005 across all cultivars were 6.1, 7.0, 7.2 and 6.6, respectively (Table 2). Self-fertile cultivars with small berry size (with the exception of 'Granny Val') tended to have the highest crop load. Yield was highest for 'Noble' (9.4) and 'Carlos' (8.7) for the duration of the experiment. In 2002, yield ranged from 4.4 ('Tara') to 9.5 ('Granny Val'). 'Carlos', 'Granny Val', 'Noble' and 'Regale' produced the highest yield (≥ 6.7). In 2003 'Carlos', 'Creek', 'Jumbo' and 'Noble' produced the highest yield (≥ 8.8), and 'Early Fry', 'Scarlet' and 'Triumph' were the least productive (4.3). The most productive cultivars in 2004

**Table 3.** Average vine vigor, berry wt. and soluble solids for 20 muscadine grape cultivars at the NFREC-Quincy from 2002-2005.

| Cultivar/year | Vigor | Berry wt (g) | Soluble solids (°Brix) |
|---|---|---|---|
| Alachua | 7.6 abcd[z] | 6.5 h | 17.5 abcdef |
| Black Beauty | 7.0 bcde | 11.9 a | 17.3 abcd |
| Black Fry | 5.8 efg | 10.6 bc | 17.7 abcd |
| Carlos | 8.8 ab | 5.4 i | 17.4 abcdef |
| Creek | 7.6 abcd | 3.0 j | 15.1 gh |
| Early Fry | 4.4 g | 10.2 bcd | 17.4 abcdef |
| Fry | 5.1 fg | 10.4 bc | 18.8 ab |
| Granny Val | 6.9 cdef | 11.0 b | 17.0 bcdef |
| Jumbo | 6.7 cdef | 9.8 cde | 15.1 gh |
| Noble | 8.9 a | 3.2 j | 16.8 cdefg |
| Pam | 7.9 abc | 12.7 a | 16.1defg |
| Pineapple | 6.0 defg | 8.7 fg | 15.7 efg |
| Polyanna | 7.4 abcde | 9.3 def | 18.2 abc |
| Regale | 7.5 abcd | 5.3 i | 14.7 h |
| Scarlet | 8.0 abc | 10.6 bc | 18.9 a |
| Summitt | 8.5 ab | 8.1 g | 18.7 ab |
| Supreme | 4.8 g | 11.9 a | 15.2 gh |
| Sweet Jenny | 7.2 abcde | 12.6 a | 16.7 cdefg |
| Tara | 7.3 abcde | 9.3 ef | 15.6 fgh |
| Triumph | 7.0 cdef | 8.2 g | 17.4 abcdef |
| | | | |
| Year | | | |
| 2002 | 7.1 | 9.5 | 18.4 |
| 2003 | 6.7 | 8.4 | 16.7 |
| 2004 | 7.0 | 8.2 | 15.6 |
| 2005 | 7.1 | 9.0 | 17.5 |

[z] Vine vigor was estimated from 1 (lowest) to 10 (highest). Mean values not followed by a letter in common within a column are significantly different by Duncan's multiple range test, $P<0.05$. Mean values by year are also included.

were 'Carlos', 'Creek', 'Granny Val', 'Noble', 'Pineapple' and 'Regale'. At the conclusion of the experiment (2005) 'Carlos' (9.0) and 'Noble' (10.0) produced the highest yield whereas 'Black Fry', 'Creek', 'Early Fry', 'Fry', 'Granny Val', 'Pam' and 'Pineapple' had a yield rating of 5.4 or less.. A tendency to bear light and heavy crops in alternate years was observed for 'Creek', 'Granny Val', 'Jumbo', 'Pam', and 'Supreme'.

'Carlos', 'Noble' and 'Summit'' had the highest vigor (≥ 8.5), and 'Early Fry', 'Fry' and 'Supreme' had the lowest vigor (≤5.1) (Table 3). Most cultivars had a vigor rating about 7.0 to which, in this rating scheme, is considered adequate vigor. Mean vine vigor varied from 6.7 to 7.1 from 2002 to 2005. Vine vigor was least for 'Early Fry' (4.4) and 'Supreme (4.8). 'Carlos', 'Creek' and 'Noble', 'Scarlet' and 'Summit' consistently had the highest vigor ratings from 2002-2005 (data not shown). At the conclusion of the experiment (2005), the vigor of all cultivars was rated 6 or higher with the exception of 'Early Fry', 'Fry',

'Granny Val', 'Pineapple' and 'Supreme' (data not shown).

Although there was a significant year effect on berry weight, the trends were similar with no cultivar*year interaction. Thus mean data are reported (Table 3). Berry weight tended to be about 1 g higher in 2002 compared to 2003 and 2004, and about 0.5 g higher than in 2005 (Table 3), otherwise trends in berry weight were similar (data not shown). Berry weight was largest for the pistillate cultivars 'Black Beauty', 'Pam', 'Supreme' and 'Sweet Jenny'. Other pistillate cultivars with a large berry size included 'Black Fry', 'Early Fry', 'Fry', 'Jumbo' and 'Scarlet'. 'Granny Val', 'Polyanna' and 'Tara' were pollenizer (self-fruitful) cultivars with a large berry size. 'Creek' and 'Noble' (3.5 g) were consistently cultivars with the smallest berry weight (2.7 to 3.8 g). Small to medium berry size (5 to 7 g) was recorded for 'Alachua' and 'Carlos', whereas 'Pineapple', 'Summit' and 'Triumph produced a medium-sized berry (7 to 9 g).

Mean soluble solids were higher in 2002 (18.4 °Brix) and in 2005 (17.5 °Brix) compared to 2003 (15.6 °Brix) and 2004 (16.3 °Brix) (Table 3); however, there was no significant cultivar*year interaction. Mean soluble solids for the four year period ranged from 14.7 °Brix ('Regale') to greater than 18 °Brix ('Fry', 'Polyanna', 'Scarlet' and 'Summit') (Table 3). In 2002, all muscadine cultivars were high in sugar and ranged from 16 to 21.3 °Brix, with the exception of 'Creek' (15.2 °Brix), and cultivars with $\geq$ 19 °Brix included 'Alachua', 'Black Fry', 'Carlos', 'Fry', 'Polyanna', 'Scarlet' and 'Summit' (data not shown). The highest °Brix in 2003 was recorded for 'Black Beauty', 'Fry', 'Polyanna', 'Scarlet' 'Summit' and 'Triumph' (data not shown). In 2004 most cultivars ranged from 14 to 17.6 °Brix with the exception of 'Creek' (13.8 °Brix), 'Regale' (12.7 °Brix) , and 'Tara' (13.9 °Brix) (data not shown). In 2005, °Brix was somewhat similar to that recorded for 2002.

In summary, the yield of most of the large-fruited pistillate cultivars was in the range of 5.6 to 6.9. 'Carlos', 'Fry', 'Granny Val', 'Jumbo', 'Noble', 'Polyanna (FL CD8-81)', 'Summit' and 'Tara' have been previously evaluated in north Florida (1, 2), and 'Carlos', 'Fry', 'Jumbo', 'Noble' and 'Summit' have been trialed in other locations (3, 6, 8, 9, 10). Our data are in agreement with previous reports. For example, 'Noble' and 'Carlos' have consistently produced higher yields than other muscadine grapes, and although 'Fry' produces a large sweet grape, it is low in vigor and suffers from leaf diseases. We are not aware of yield and berry quality data concerning the remaining 12 cultivars in this study.

The ratio of vigor/yield may be considered an index of vine health or vine stress. This ratio was very close to 1.0 for the majority of the cultivars which is indicative of a balance of vegetative and reproductive growth. 'Supreme' was the cultivar with the lowest average ratio (0.76) which an indication of overproduction and vine stress, while 'Scarlet' was the cultivar with the highest vigor to yield ratio (1.43). All pistillate cultivars had a berry weight in excess of 10.0 g except 'Jumbo' (9.8 g). 'Granny Val' was the only self-fertile (or pollenizer cultivar) with a berry weight of 11.0 g. The other self fertile (or pollenizer) cultivars with a fairly large berry size included 'Polyanna' and 'Tara' (both 9.3 g). The average °Brix of all the muscadine cultivars combined was about 17.0. 'Black Beauty', 'Black Fry', 'Fry', 'Granny Val', 'Pam', 'Polyanna', 'Scarlet', 'Summit' and 'Sweet Jenny' produced berries with the highest °Brix, and 'Creek' and 'Jumbo' produced the berries lowest in °Brix. All cultivars had a minimum soluble solids of 13 to 15 °Brix which are often required by processing plants (9)

Cultivar descriptions will follow:

**'Alachua'** produces a medium-sized, black berry. Vines are self fruitful, productive and medium-high in vigor. Berries ripen uniformly mid-season. Berries have a medium-high % dry stem scar. The fresh market potential of

'Alachua' is limited due to a berry size that is not competitive.

**'Black Beauty'** is a patented pistillate cultivar that produces an attractive very large black berry high in sugar. Berries are crunchy when ripe. It has a medium-high % dry stem scar. Vine vigor and yield are moderate. Berry ripening is early to mid season. 'Black Beauty' appears to be a good fresh market grape**.**

**'Black Fry'** is a patented pistillate cultivar. Berry size is large and black in color. Berries have a wet stem scar. Vine vigor and yield are in the low to moderate range. Harvest is early to mid season. It has a medium % dry stem scar. It is reported to have leaf disease problems (5).

**'Carlos'** is a self-fruitful grape that is vigorous and productive. Yields are as high or higher than any muscadine cultivar. 'Carlos' will produce the tonnage and quality required for juice and wine production. Berry color is bronze, size is medium small, and ripening is mid-season. Berries have a medium-high % dry stem scar. 'Carlos' can show symptoms of Pierce's disease, especially in years of high yields combined with drought stress.

**'Creek'** is self-fruitful and produces a berry that is higher in acid than most muscadine grapes. Berry size is very small, purple in color with a wet stem scar. Vine vigor and yield are moderately high and ripening season is late. To my knowledge color stability for juice or wine production has not been tested.

**'Early Fry'** is a patented pistillate cultivar. As the name suggests, it resembles 'Fry', but it is an early season grape. Berry size is large and color is bronze. 'Early Fry' has a medium % dry stem scar. Vine vigor and yield have been rated low, although they have been rated high in Georgia.

**'Fry'** is the industry standard for fresh market grapes. It is a pistillate cultivar that produces a large, sweet berry that is bronze in color. Berry ripening is uneven and can last up to a month or more. Vine vigor is relatively low and yield is moderate to low. It has a wet stem scar. 'Fry' is more susceptible to leaf disease than most other cultivars of muscadine grapes.

**'Granny Val'** is a patented grape. It may be the largest pollenizer grape available. Berries are bronze, but not as sweet as 'Fry'. Vine vigor is moderate and yield is high. It has a high % dry stem scar when fully ripe. Due to a tendency of overcropping, it should be pruned to two node spurs. Harvest season is the latest of all cultivars tested.

**'Jumbo'** is a pistillate cultivar that produces a large dark purple grape that is not especially sweet. 'Jumbo' ripens during mid season. 'Jumbo' has a wet stem scar'. Vine vigor and yield were moderate, but production has been variable in other regions. 'Jumbo' has been largely replaced by other cultivars such as 'Supreme' and 'Black Beauty'.

**'Noble'** is the industry standard for juice and red wine production. Vine vigor and yield are very high. It produces a small purple berry with a wet stem scar. 'Noble' is self-fertile and berry ripening is fairly uniform. Juice or wine made from 'Noble' is less musky, and has better color retention than other purple/black muscadine cultivars.

**'Pam'** is a patented pistillate cultivar. It produces a very large, greenish-bronze berry. 'Pam' has medium high vigor and a low to moderate yield and ripens early- to mid-season. 'Pam' produces a very attractive berry with a mild muscadine flavor. It has a high % dry stem scar. It has some potential as a fresh market grape**.**

**'Pineapple'** is a patented grape that is self-fruitful. Berry color is bronze and size is medium. Ripening is mid- to late-season. Vine vigor and yield is moderate. It has a moderately wet scar. 'Pineapple' is reported to over produce under certain circumstances. It is also said to have a pineapple flavor, although it was hard for the author to detect.

**'Polyanna'** is self-fruitful and produces a moderately large grape. Berry color is dark purple. Vine vigor and yield are moderate to high. Berry flavor is very sweet and berry appearance is attractive. Harvest season is

medium to late. 'Polyanna' has a dry % stem scar. 'Polyanna' has potential as a pollenizer for pistillate cultivars.

**'Regale'** is self-fertile and produces a small-medium sized black grape. It has moderate vigor and moderate to high yield. It is not particularly high in sugar. It has a wet stem scar. It is too small to be competitive for the fresh market.

**'Scarlet'** is a pistillate cultivar that produces a large pink-red berry. It has medium to high vigor, but yield is low. It has a moderate % dry stem scar. Berries are sweet, but are prone to blemishes due to a variety of causes.

**'Summit'** is a pistillate cultivar that produces a medium-large sized bronze grape. 'Summit' gapes are very high in sugar. Vigor is high and yield is moderate to high. Vine vigor, disease resistance and yield are higher than that of 'Fry', although berry size is smaller. 'Summit' has a dry stem scar. It is a good fresh market grape.

**'Supreme'** is a patented, pistillate cultivar. It produces a very large, attractive, dark purple grape. Vine vigor was low and yield was moderate. It has a wet stem scar and berries are crunchy when ripe. 'Supreme' tends to overcrop and should be pruned to two nodes per spur. Harvest season is mid to late. It has good potential as a fresh market grape if it does not overcrop.

**'Sweet Jenny'** is a patented, pistillate cultivar. It produces a very large bronze berry. Vine vigor and yield are moderate. It has an early to mid harvest season. 'Sweet Jenny' has a moderate to high % dry stem scar. Blemishes on berries were more apparent than other cultivars.

**'Tara'** produces a medium-large bronze grape. It is self-fertile. Vine vigor and yield are moderate. It has an early to mid harvest season. It has a dry stem scar. 'Tara' has potential as a pollinizer cultivar for pistillate cultivars.

**'Triumph'** is a self-fertile cultivar that produces medium-large berries. Berry color is bronze with a pinkish hue. It has a dry stem scar. Vine vigor and yield were moderate. 'Triumph' has an early to mid harvest season.

**Literature Cited**


1. Andersen, P. C. 1991. Performance of cultivars and selections of muscadine grapes in north Florida. Fruit Var. J. 46: 245-249.
2. Andersen, P. C., M. W. Bryan and L. H. Baker. 1985. Effect of two wire vertical and Geneva double curtain training systems on berry quality and yield of muscadine grapes. Proc. Fla. State Hort. Soc. 98:175-178.
3. Balerdi, C. F. and J. A. Mortensen. 1969. Performance of muscadine grapes (*Vitis rotundifolia* Michx) in central Florida. HortScience 4: 252-253.
4. Bates, R. P., R. L. Coleman and C. J. Wagner Jr. 1981. Symposium: Grapes in Florida. Grape processing and utilization in Florida. Proc. Fla. State Hort. Soc. 94:343-347.
5. Hopkins, D. L., H. H. Mollenhauer and J. A. Mortensen. 1971. Tolerance to Pierce's disease and the associated Rickettsia-like bacterium in muscadine grape. J. Amer. Soc. Hort. Sci. 99:436-439.
6. Krewer, G., S. C. Meyers and M. E. Feree. 2000. Commercial Muscadine Culture. Univ. of Georgia Coop. Ext. Ser. 16 pp.
7. Mortensen, J. A. and C. P. Andrews. 1981. Symposium: Grapes in Florida. Grape cultivar trials and recommended cultivars for Florida. Proc. Fla. State Hort. Soc. 94:328-331.
8. Mortensen, J. A. and J. W. Harris. 1989. Yields and other characteristics of muscadine grape cultivars at Leesburg. Proc. Fla. State Hort. Soc. 102:223-226.
9. Olein, W. C. 1990. The Muscadine Grape: Botany, Viticulture, History and Current Industry. HortScience 25:732-739.
10. Stoffela, P. J., J. A. Mortensen, N. C. Hayslip and J. B. Brolmann. 1982. Evaluation of muscadine grape cultivars in south Florida. Proc. Fla. State Hort. Soc. 95:90-92.